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UNITED STATES PATENT OFFICE.

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HIGH EXPLOSIVE.

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To all whom it may concern:

Be it known that I, CLIFFORD A. WOODBURY, a citizen of the United States, and a resident of Media, in the county of Delaware and State of Pennsylvania, have invented certain new and useful High Explosives, of which the following is a specification.

This invention relates to explosives, and particularly to dynamites, containing as an essential constituent a hydrocarbon derivative comprising a chain of carbon atoms and having a nitro group ($-NO_2$) and a nitrate group ($-O-NO_2$) attached respectively to two adjacent carbon atoms of said chain.

In the commonest and most successful types of dynamite now used, nitroglycerine constitutes the most important of all the ingredients. Being a liquid of high gravity, it produces plastic, high density dynamites. It has a high velocity of detonation and high strength, and the ability even when present in small percentage, of imparting good sensitiveness and propagating power to dynamite. There are, however, a number of serious objections to nitroglycerine such as high cost and high freezing point.

Many attempts have been made to produce dynamite cheaper and of lower freezing point than those obtainable from nitroglycerine. For example, ammonium nitrate, nitro-aromatics, nitrated sugars, etc., are used in place of a part of the nitroglycerine, but no liquid or solid explosive has been developed to my knowledge equaling or approaching nitroglycerine in both properties and economy. The dinitrates of the glycols, such as ethylene and propylene glycol, produce dynamites approaching those obtainable from nitroglycerine but these are at present more expensive than nitroglycerine due to the costly methods necessary in order to produce the glycols.

One object of my invention is to provide a dynamite composition containing in place of nitroglycerine a liquid explosive which may be readily prepared from such inexpensive raw materials as the unsaturated hydrocarbons of the olefine series obtained as by-products in the manufacture of cracked gasoline. More particularly, the object of my invention is to provide a substitute for nitroglycerine containing a hydrocarbon in which a nitro group is attached to one carbon and a nitrate group attached to an adjacent carbon atom.

An explosive made in accordance with my invention, may contain as one ingredient any hydrocarbon derivative having a chain of, say, from 2 to 4 carbon atoms containing a nitro group attached to one carbon atom of the chain and a nitrate group attached to an adjacent carbon atom; for example, β-nitro-ethyl nitrate $CH_2(NO_2).CH_2(NO_3)$. Compounds of this type can be produced cheaply by passing the gaseous ethylenic hydrocarbon, for example, ethylene or propylene, directly into a mixed acid containing 50% H_2SO_4, and 50% HNO_3 under agitation and cooling, the temperature being kept between 10 and 30° C., and preferably at 20° C. A reaction takes place whereby a portion of the hydrocarbon, assuming this for example to be ethylene, is transformed into a mixture consisting chiefly of β-nitro-ethyl nitrate and ethylene glycol dinitrate. On standing, this mixture separates from the acid as an oily product and may be purified by washing repeatedly with water.

If desired, I may then isolate the beta-nitro-ethyl nitrate, or other beta-nitro-alkyl nitrate, as the case may be, by vacuum fractional distillation, but since this is a tedious and dangerous operation I prefer to use the β-nitro-ethyl nitrate in mixture with the ethylene glycol dinitrate which is produced with it.

β-nitro-ethyl nitrate is a liquid with a gravity of about 1.47. It has a very high oxygen content and a nitrogen content of 20.6%. The liquid obtained as described above, containing β-nitro ethyl nitrate and glycol dinitrate, has a gravity of 1.48–1.49 at 63° F. and a nitrogen content of about 18%, though this may vary depending upon the exact method of treatment. This liquid has remained unfrozen at a temperature as low as —40° F. When mixed with nitrocellulose the above described liquid becomes gelatinized.

I have discovered that β-nitro ethyl nitrate and mixtures of β-nitro ethyl nitrate with ethylene glycol dinitrate constitute excellent explosives, especially when used in dynamites of the composition hereinafter described. For example, I may absorb the

mixture of β-nitro-ethyl nitrate and glycol dinitrate in a properly balanced mixture of a carbohydrate such as wood meal and an alkali-metal nitrate such as sodium nitrate, the product consisting a straight dynamite. Or I may use as additional ingredients one or more of the following substances: ammonium nitrate, ammonium perchlorate, nitro-cellulose, or any other of the ingredients commonly used in the manufacture of commercial nitro-glycerine dynamites or gelatins. I may in some cases use the mixture of β-nitro-ethyl nitrate in conjunction with nitroglycerine in dynamites or gelatins for the purpose of lowering the freezing point of the nitroglycerine, thereby increasing the tendency of the resulting dynamite to resist freezing.

The following compositions may be cited as examples of dynamites in which this product may be used, though it is to be understood that my invention is not limited to the compositions cited.

(1)

	Per cent.
β-nitro-ethyl nitrate	10–30
Ethylene glycol dinitrate	20– 0
Sodium nitrate	55
Wood meal	14
Chalk	1
	100

(2)

	Per cent.
β-nitro-ethyl nitrate	6
Ethylene glycol dinitrate	12
Trinitroglycerine	22
Sodium nitrate	46
Wood meal	13
Chalk	1
	100

(3)

	Per cent.
β-nitro-ethyl nitrate	11
Ethylene glycol dinitrate	22
Nitro-cellulose	1
Sodium nitrate	50
Corn starch	11
Wood meal	4
Chalk	1
	100

(4)

	Per cent.
β-nitro-ethyl nitrate	6
Ethylene glycol dinitrate	12
Ammonium nitrate	21
Sodium nitrate	46
Wood meal	9
Sulphur	5
Chalk	1
	100

(5)

	Per cent.
β-nitro-ethyl nitrate	6
Ethylene glycol dinitrate	12
Ammonium perchlorate	20
Sodium nitrate	44
Wood meal	17
Chalk	1
	100

(6)

	Per cent.
β-nitro-ethyl nitrate	25
Sodium nitrate	59
Wood meal	15
Chalk	1
	100

(7)

	Per cent.
β-nitro-ethyl nitrate	3
Glycol dinitrate	7
Ammonium nitrate	80
Wood pulp	10
	100

I claim:—

1. An explosive mixture containing as one ingredient a product obtainable by the direct nitration, with mixed nitric and sulfuric acids, of a hydrocarbon of the olefine series containing from two to four carbon atoms.

2. A dynamite containing as one ingredient a nitro-nitrate derivative of a hydrocarbon of the olefine series containing from two to four carbon atoms.

3. An explosive mixture containing as one ingredient a product obtainable by the direct nitration of ethylene with mixed nitric and sulfuric acids.

4. A dynamite containing as one ingredient beta-nitro-ethyl nitrate.

5. An explosive mixture comprising a beta-nitro-alkyl nitrate and an inorganic nitrate.

6. An explosive mixture comprising beta-nitro-ethyl nitrate and sodium nitrate.

7. An explosive mixture comprising an inorganic nitrate and from about 10 to 30% of beta-nitro-ethyl nitrate.

8. An explosive mixture comprising sodium nitrate and from about 10 to 30% of beta-nitro-ethyl nitrate.

9. A dynamite comprising sodium nitrate, a carbohydrate, and a beta-nitro-alkyl nitrate having from two to four carbon atoms.

10. A dynamite comprising an inorganic nitrate, a carbohydrate, and from 3 to 30% of beta-nitro-ethyl nitrate.

11. A dynamite comprising an inorganic nitrate, a carbohydrate, beta-nitro-ethyl nitrate and ethylene glycol dinitrate.

In testimony whereof I affix my signature

CLIFFORD A. WOODBURY.